PATENT SPECIFICATION

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(19)

(54) METHOD OF BUILDING TYRES

(71) We, COMPRESSED TREAD SYSTEMS LIMITED, a British Company, of Mill Lane, Alton, Hampshire, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is performed, to be particularly described in and by the following statement:—

This invention relates to a method of building a tyre.

It is known to construct a tyre from uncured materials using a building machine, and such machines generally fall into one of two categories, namely, a single stage machine or a two stage machine. In a single stage machine, an uncured tyre carcase is first built up on a tyre building drum as a cylindrical assembly incorporating body plies, beads and sidewalls. The cylindrical assembly is then shaped into a toroidal form by expanding the centre portion of the building drum. A breaker assembly is applied to the outer periphery of the shaped carcase and the uncured tyre assembly is completed by placing a strip of uncured tread rubber (without a tread pattern) circumferentially around the outer periphery of the breaker plies. The building drum is then collapsed and the uncured tyre assembly is removed and transferred to a curing mould where it is cured, ready for use.

In a two-stage machine, the uncured tyre carcase is built up as a cylindrical assembly on a first stage building drum, the carcase is then removed from this drum and relocated on a second stage building drum where it is formed into a toroidal shape, the breaker assembly and tread material then being added to form an uncured tyre assembly. The uncured assembly is then transferred to a curing mould and cured, as described in the single-step machine process.

In both of the aforementioned processes, the tread pattern is moulded into the tread in the curing mould during curing of the uncured tyre assembly.

During the tread-pattern forming process, some movement of the tyre assembly inevitably occurs due to the movement of the tread against the inwardly projecting tread pattern ribs on the inner periphery of the curing mould. Such movement produces an overall diametrical expansion of the tyre assembly of from 1% to 4%, according to the type of curing mould which is employed. Inevitably, even small amounts of uncontrolled movement in the curing mould allows relative movement between the tyre components to occur, particularly in the crown area, resulting in poor uniformity, and hence uneven wearing and performance properties, in the finished product.

By means of the present invention it is possible to produce tyres of extremely high uniformity using for the most part existing tyre building equipment, thereby obviating the need for expensive capital investment in new plant and machinery. Existing tyre building equipment can, in most cases, be simply and inexpensively modified to carry out the process of the invention.

According to the invention there is provided a method of building a tyre comprising:

(a) bonding an uncured tread band to an uncured breaker assembly and curing to form a precured combination with a tread pattern in the tread band,

(b) locating the precured combination on the inner periphery of a retaining device, the retaining device being openable so as to permit removal of the combination of tread band and breaker assembly therefrom without having to distort the shape of the combination,

(c) providing an uncured cylindrical tyre carcase on a tyre building drum,

(d) aligning the building drum and the retaining device so that the mid-circumferential planes of the precured combination of tread band and breaker assembly, and uncured tyre carcase, are c planar,

(e) moving the crown region of the tyre carcase into contact with the precured com-

bination of tread band and breaker assembly and bonding the uncured carcase to the precured combination,

(f) separating the building drum and the retaining device,

(g) opening the retaining device and removing therefrom the complete assembly of uncured tyre carcase and precured combination of tread band and breaker assembly without distorting the shape of the complete assembly or disturbing the relative position of the precured combination of tread band and breaker assembly in the complete assembly,

(h) transferring the complete assembly to a curing mould whose crown diameter and crown profile are substantially the same as those of a retaining cavity which accommodates the crown portion of the complete assembly in the retaining device, and

(i) curing to form a finished tyre.

Preferably, the retaining device is a ring constructed in two semi-circular halves which are hinged together by a hinge pin at one join between the halves and locked together at the other join. The locked join may be unlocked so that one half may swing about the hinge pin in the plane of the ring, thereby permitting removal of a tyre assembly from the ring. Alternatively, the retaining ring can be constructed to open along its mid-circumferential plane or can be a segmented ring arranged to open radially.

The precured combination of tread band and breaker assembly may be transferred to a retaining ring to be used with the building drum.

The transfer of the precured combination of tread band and breaker assembly facilitates the construction of the precured tread band and breaker assembly combination in a different part of the plant to that occupied by the building drum and its associated retaining ring, thus giving added flexibility to the method of the invention.

The surface of the breaker assembly, or the surface of the crown region of the tyre carcase, or both surfaces, may be coated with a suitable bonding material before the tyre is formed.

The method according to the invention is particularly advantageous because it reduces the total number of curing operations to two, namely, the initial cure for the combined tread/breaker assembly and the second cure for the final tyre assembly.

The final curing mould is preferably split into two halves along its mid curcumferential plane so that the tyre assembly may be laid in the mould cavity of one half, and the other half closed on top of the assembly. Alternatively, a radially pening segmented curing mould may be used.

Such moulds are well known in the tyre building art but, since they have hitherto been used with tyre assemblies having uncured treads, the inner periphery of the mould generally has inwardly projecting tread-pattern ribs for sinking into the uncured tread. Since the method of the present invention utilises a precured combination of tread band and breaker assembly, which already has a tread pattern impressed therein, it is envisaged that a smooth crown surface can be arranged within the mould to replace the tread-pattern ribs and provide a smooth surface against which the outer periphery of the tread can bear during the curing process. A particularly important feature of the present invention is that the crown diameter and profile of the tyre assembly on removal from the retaining device should be substantially the same as those of the curing mould. This is because any changes in these dimensions during the curing process could cause undesirable movement of the breaker assembly which, as has been stated earlier, leads to poor uniformity in the finished product. In order to maintain the constant or minimum undisturbed dimensions of the tyre through the tyre building process the crown surface of the mould is dimensioned so that the finished crown diameter of the tyre in the mould substantially matches that of the tyre assembly in the retaining device. Hence, it is possible to use existing curing moulds in the process of the present invention simply by modifying the moulds by machining them to obtain a smooth crown surface, or to accept crown inserts of the appropriate size.

The crown inserts are preferably metallic, annular components, but is it also possible to utilise arcuate inserts to build up the required profile inside the curing mould. It will be appreciated that plain crowned curing moulds can be manufactured specifically for carrying out the process of the present invention, in which case the crown inserts would not be required.

In order to locate the breaker assembly accurately against the tread while effecting the precuring of the tread and breaker assembly, it is advantageous to provide a circumferential channel on the inner periphery of the tread, in which is located the breaker assembly. The provision of this channel further reduces the tendency of the breaker assembly to move from its central postion during the tyre building process.

The invention is now described, by way of example, with reference to the accompanying drawings, wherein

Figure 1 is a schematic side elevation of a tyre building drum and a tread retaining ring.

Figure 2 is the tyre building drum and tread retaining ring of Figure 1, with the retaining ring partly in section, showing a tyre carcase and a pre-cured tread/breaker assembly combination in position.

Figure 3 is the tyre building drum and tread retaining ring of Figure 2, showing the building drum located within the retaining ring and the tyre carcase being shaped into a toroidal form.

Figure 4 is the tyre building drum and tread retaining ring as shown in Figure 1, showing a newly assembled tyre in the retaining ring.

Figure 5 is an end elevation of the tread retaining ring of Figure 1 showing the ring-open position in chain dotted lines.

Figure 6 is a section through part of a curing press for curing a tyre assembly, showing the press open.

Figure 7 is a section through the press of Figure 6 showing the press closed with the tyre assembly located therein.

Referring to Figure 1 of the drawings, a conventional tyre building drum 1 is supported on a horizontal arm 2 which is fixed to a support structure 3. The arm 2 defines the longitudinal axis of the drum 1. A tyre tread retaining ring 4 is mounted on a support block 5 so that the mid-circumferential plane of the ring 4 is vertical, the ring 4 being spaced horizontally from the drum 1 so that the central, horizontal axis of the ring 4 is aligned with the arm 2. The block 5 is slidably mounted on guide rods 6, the block 5 being moved horizontally towards or away from the drum 1 by means of pneumatic pressure, provided by an actuating cylinder 7, acting on block 5 to traverse it along the rods 6.

Actuating cylinder 7 is a double acting assembly in which compressed air is admitted to either side of a piston slidably mounted in a cylindrical housing, a rod 7a being attached to the piston. Thus block 5 is moved towards or away from the drum 1 by applying compressed air to one side or the other of air cylinder 7.

The block 5 can also be moved horizontally towards or away from the drum 1 by other methods, for example, by being slid manually along rails (not shown) on the floor.

Referring to Figure 2 of the drawings, the tyre building process of the invention is commenced by forming a basic tyre carcase 8 on the building drum 1 according to carcase building methods well known in the art. An integral, precured tread and breaker assembly is then formed by bonding an uncured tread to an uncured breaker and curing to form a precured combination. The pre-moulded integral pre-cured tread/breaker assembly combination 9 with the breaker assembly indicated at 10, is then located within the retaining ring 4.

Referring to Figure 5 of the drawings, the retaining ring 4 is constructed in two semi-circular halves which are pivotally connected by a hinge pin 11, the two halves being secured together by means of a locking arrangement 12 which is located diametrically opposite the hinge pin 11. The locking arrangement includes a bolt 13 connecting two brackets 14, 15, each bracket being fixed to a half of the retaining ring 4. A locking nut 16 is screwed down over the bolt to hold the two brackets 14, 15 together, and is removed when it is desired to open the ring 4. When the locking nut 16 is removed, the upper half is simply pivoted away from the lower half by moving it in a vertical plane about hinge pin 11.

It will be appreciated that the combination 9 has been built and precured in a separate ring. Thus, by using this type of split retaining ring, the combination 9 may be built up in one part of the plant, removed and transferred to the split retaining ring near the building drum 1 ready for the next stage of the tyre building process.

Referring now to Figure 3 of the drawings, when the combination 9 is located within the ring 4, the support block 5 is slid towards the drum 1 until the mid-circumferential planes of the tyre carcase 8 and combination 9 coincide. The drum 1 then shapes the carcase 8 into a toroidal from so that the crown section 18 of the carcase 8 contacts the inner periphery of the combination.

A layer of bonding material may be interposed between the crown section 18 and the combination 9 so that the carcase 8 can adhere to the combination 9.

Alternatively, surfaces to be bonded may be solutioned, the bond being assisted by the use of cushion gum or bonding agent.

The drum 1 is then collapsed, and the ring 4, containing a complete tyre assembly 19 of carcase 8, and combination 9, is moved horizontally away from the drum 1, back to its initial position as shown in Figure 1 of the drawings (see Figure 4).

The ring 4 is opened by removing locking nut 16 and swinging back one half of the ring. The tyre assembly 19 is then removed from the ring without distorting the shape of the assembly 19 or disturbing the accurate position of breaker assembly in the combination 9.

Referring now to Figures 6 and 7 of the drawings, the tyre assembly 19 is transferred to a curing mould 20 for curing and production of the finished tyre.

The mould 20 is a convential split ring curing mould, which is divided circumferentially into two halves 21 and 22, preferably along the mid-circumferential plane. With the mould 20 in its open position (see Figure 6) the assembly is placed in the bottom half 21 whose side wall region 23 is profiled to match the desired sidewall shape of the assembly 19. Before the assembly 19 is placed in position, however metallic crown inserts 24 and 25 are located in each half 21 and 22 respectively so as t provide a

smooth contour on the crown region of the mould. The size and shape of the inserts 24 and 25 are such that, when they are in position, the mould cavity which is produced by halves 21 and 22 coming together, as shown in Figure 7, produces the finished contour into which the assembly 19 is shaped. Since the tread pattern is performed on the combination 9, the surfaces of inserts 24 and 25 which engage the crown region of the tyre are smooth so that minimum movement of the tyre assembly occurs within the mould during the curing process.

It is, of course possible to machine a conventional curing mould to obtain the desired configuration.

In order to complete the tyre, the mould half 22 is closed over half 21, as shown in Figure 7, so as to enclose completely the assembly 19 within the mould cavity. The assembly 19 may then be cured by applying heat and pressure to the assembly in accordance with conventional techniques.

It will be appreciated that existing curing moulds can easily be modified by machining, or can be made to accept crown inserts of an appropriate size, so that the mould cavity matches the size and shape of the crown region of the tyre assembly when taken straight from the retaining ring.

Thus, in order to carry out the process of the invention, it would be necessary in most cases simply to provide a retaining ring which can be opened to permit easy removal of a tyre assembly and to modify existing curing moulds in the matter described above, or to provide new curing moulds or dies with a plain crown contour.

Although the invention has been described with reference to a curing mould containing replaceable crown inserts, it is within the scope of the invention to place a single, plain annular band crown insert within the retaining ring and to transfer the complete tyre assembly, retained within the crown insert, to a curing mould which has been modified to receive the crown insert.

In this case, the end result would be similar to that depicted in Figure 7, except that the crown insert would be integrally formed rather than formed as two halves 24 and 25 which abut when the mould is closed.

WHAT WE CLAIM IS:—

1. A method of building a tyre comprising:—

(a) bonding an uncured tread band to an uncured breaker assembly and curing to form a precured combination with a tread pattern in the tread band,

(b) locating the precured combination on the inner periphery of a retaining device, the retaining device being openable so as to permit the removal of the combination of tread band and breaker assembly therefrom without having to distort the shape of the combination,

(c) providing an uncured cylindrical tyre carcase on a tyre building drum,

(d) aligning the building drum and the retaining device so that the mid-circumferential planes of the precured combination of tread band and breaker assembly, and uncured tyre carcase, are coplanar,

(e) moving the crown region of the tyre carcase into contact with the precured combination of tread band and breaker assembly and bonding the uncured carcase to the precured combination,

(f) separating the building drum and the retaining device,

(g) opening the retaining device and removing therefrom the complete assembly of uncured tyre carcase and precured combination of tread band and breaker assembly without distorting the shape of the complete assembly or disturbing the relative position of the precured combination of tread band and breaker assembly in the complete assembly,

(h) transferring the complete assembly to a curing mould whose crown diameter and crown profile are substantially the same as those of a retaining cavity which accommodates the crown portion of the complete assembly in the retaining device, and

(i) curing to form a finished tyre.

2. A method according to claim 1 wherein the tread band is provided with a circumferential channel on its inner periphery for accurately locating the breaker assembly.

3. A method according to claim 1 or claim 2 wherein at least one crown insert is detachably positioned within the mould cavity of the curing mould so as to give the cavity a crown diameter substantially the same as that of the uncured complete tyre assembly.

4. A method according to claim 1 substantially as hereinbefore described with reference to the accompanying drawings.

5. A tyre whenever made by a method according to claim 1 or claim 2.

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1592854 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1.

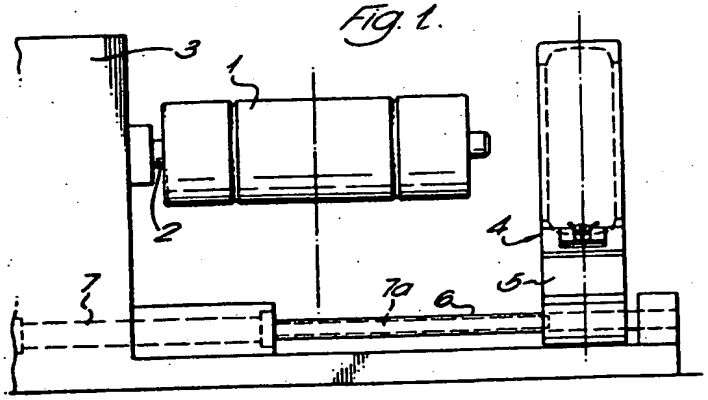
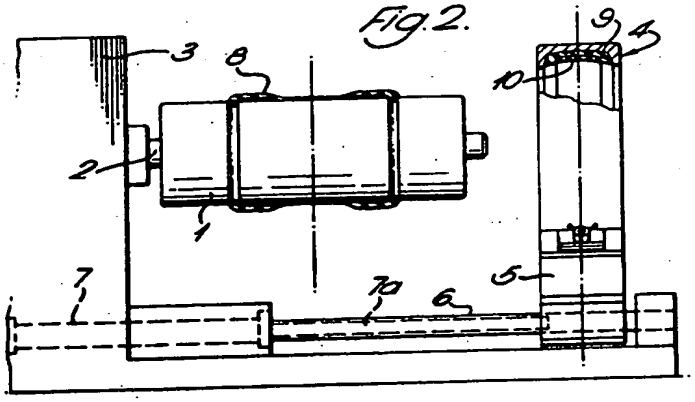


Fig. 2.



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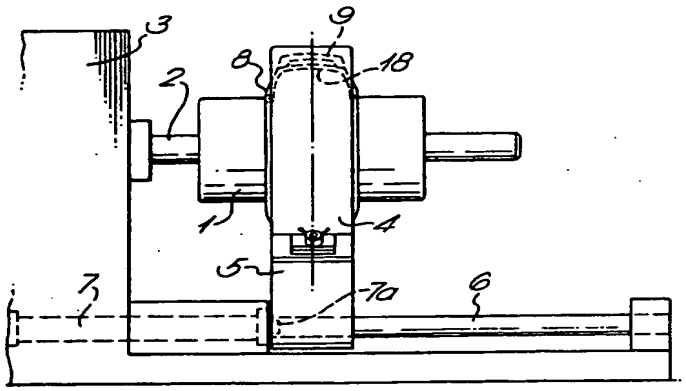
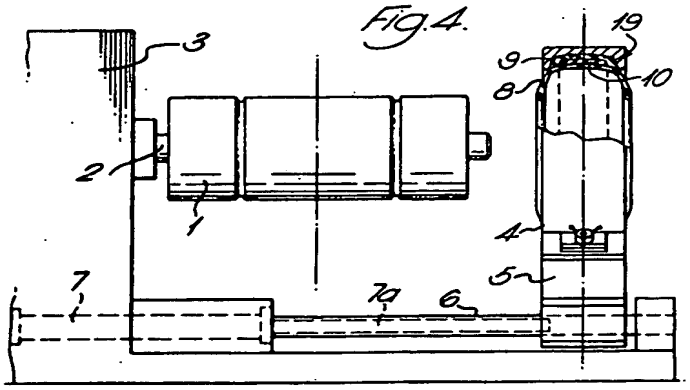


Fig. 3.

Fig. 4.



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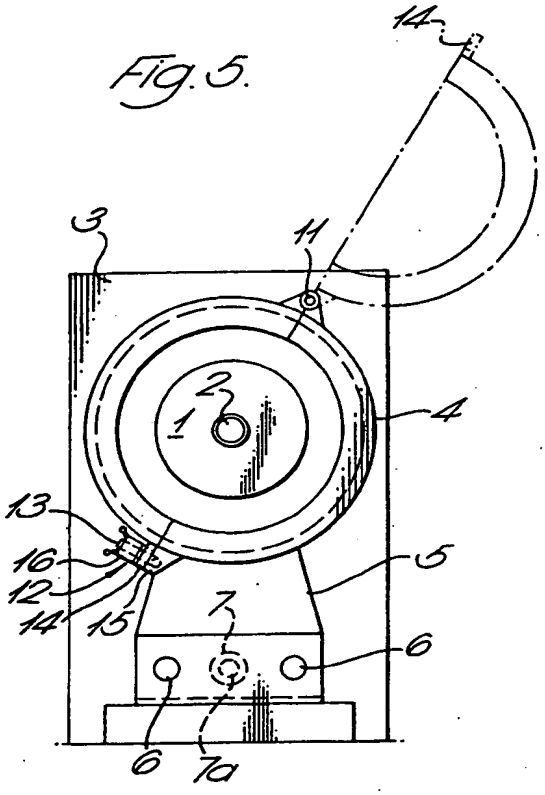
Sheet 3

Fig. 5.



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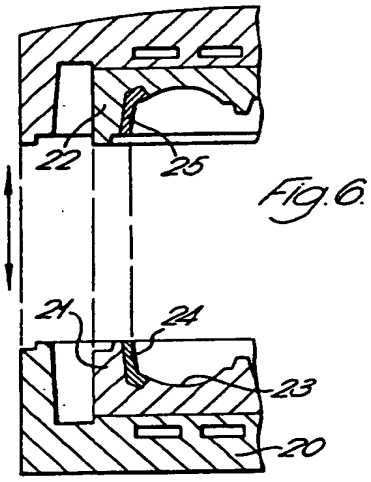

Fig.6.

Fig.7.